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Ottawa Hull K1A 0G9

(21) (A1)	2,191,049
(22)	1996/11/22
(43)	1997/05/29

(51) Int.Cl. <sup>6</sup> A47L 5/38; A47L 9/00

(19) (CA) **APPLICATION FOR CANADIAN PATENT** (12)

(54) Central Vacuum with Acoustical Damping

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(30) (US) 08/563,287 1995/11/28 - US

(57) 20 Claims

6,737,797

Notice: This application is as filed and may therefore contain an incomplete specification.



CENTRAL VACUUM WITH ACOUSTICAL DAMPING

## ABSTRACT OF THE DISCLOSURE

1  
2 A central vacuum unit having an acoustic damping  
3 system is provided. The central vacuum unit includes a  
4 canister having a sidewall forming a hollow interior and  
5 a lid closing an end of the sidewall, a vacuum motor  
6 within the canister which emits noise during operation,  
7 at least one cooling air inlet for admitting cooling air  
8 into the hollow interior, and at least one cooling air  
9 outlet in the sidewall for exhausting the cooling air  
10 from the hollow interior. Additionally, the sidewall has  
11 an exhaust port and the motor has an exhaust pipe  
12 extending through the exhaust port. The acoustic damping  
13 system includes an acoustic damping tunnel, an acoustic  
14 damping canopy, and an exhaust port seal. The acoustic  
15 damping tunnel is within the hollow interior and forms a  
16 pathway between the hollow interior and the cooling air  
17 outlet. The pathway is lined with a sound absorbing  
18 material so that the tunnel reduces noise emitted from  
19 the hollow interior through the cooling outlet. The  
20 acoustic damping canopy is attached to the canopy over  
21 the cooling air inlet. The canopy has an inlet and forms  
22 a serpentine pathway between the canister cooling air  
23 inlet and said canopy inlet to reduce noise emitted from  
24 the hollow interior through the canister cooling air  
25 inlet. The exhaust port seal covers the exhaust port to  
26 reduce noise emitted from the hollow interior through the  
27 exhaust port. The exhaust port seal preferably includes  
28 flexible foam bonded to the canister sidewall.

WHAT IS CLAIMED IS:

1           1. A central vacuum unit comprising:  
2           a canister forming a hollow interior;  
3           a vacuum motor within said canister which emits  
4 noise during operation;  
5           at least one opening in said canister; and  
6           an acoustic damping tunnel within said hollow  
7 interior and forming a pathway between said hollow  
8 interior and said opening, said pathway being lined with  
9 a sound absorbing material, whereby said tunnel reduces  
10 noise emitted from said hollow interior through said  
11 opening.

1           2. The central vacuum unit according to claim 1,  
2 wherein said canister has a sidewall and said at least  
3 one opening is a plurality of slots.

1           3. The central vacuum unit according to claim 2,  
2 wherein said opening is a cooling air outlet for said  
3 motor.

1           4. The central vacuum unit according to claim 1,  
2 wherein said canister has a side wall, said opening is in  
3 said side wall, and said tunnel is sealed to said  
4 sidewall so that noise within said hollow interior is  
5 forced to pass through said tunnel to exit said canister  
6 through said opening.

1           5. The central vacuum according to claim 1, wherein  
2 said sound absorbing material is an open cell foam.

1           6. The central vacuum according to claim 5, wherein  
2 said open cell foam comprises combustion modified  
3 polyether polyurethane foam.

1           7. A central vacuum unit comprising:  
2           a canister forming a hollow interior;

3 a vacuum motor within said canister which emits  
4 noise during operation;  
5 at least one opening in said canister; and  
6 an acoustic damping canopy outside said canister and  
7 covering said opening, said canopy having at least one  
8 inlet and forming a serpentine pathway between said  
9 opening and said inlet to reduce noise emitted from said  
10 hollow interior through said opening and said inlet.

1 8. The central vacuum unit according to claim 7,  
2 wherein said canister has a side wall and a lid closing  
3 an end of the canister, and said at least one opening is  
4 a cooling air inlet of said motor extending at said lid.

1 9. The central vacuum unit according to claim 7,  
2 wherein said canopy comprises molded plastic.

1 10. The central vacuum unit according to claim 9,  
2 wherein sound absorbing material is provided along at  
3 least a portion of said pathway.

1 11. The central vacuum according to claim 10,  
2 wherein said sound absorbing material is an open cell  
3 foam.

1 12. The central vacuum according to claim 11,  
2 wherein said open cell foam comprises combustion modified  
3 polyether polyurethane foam.

1 13. A central vacuum unit comprising:  
2 a canister having a sidewall forming a hollow  
3 interior and a lid closing one end of the sidewall;  
4 a vacuum motor within said canister which emits  
5 noise during operation;  
6 an at least one cooling air inlet for admitting  
7 cooling air into said hollow interior;  
8 at least one cooling air outlet in said sidewall for

9 exhausting the cooling air from said hollow interior; and

10 an acoustic damping tunnel within said hollow  
11 interior and forming a pathway between said hollow  
12 interior and said cooling air outlet, said pathway being  
13 lined with a sound absorbing material, whereby said  
14 tunnel reduces noise emitted from said hollow interior  
15 through said cooling air outlet.

1 14. The central vacuum unit according to claim 13,  
2 wherein said tunnel is sealed to said sidewall so that  
3 noise within said hollow interior is forced to pass  
4 through said tunnel to exit said canister through said  
5 cooling air outlet.

1 15. The central vacuum according to claim 13,  
2 wherein said sound absorbing material is an open cell  
3 foam.

1 16. The central vacuum unit according to claim 13,  
2 further comprising an acoustic damping canopy over said  
3 lid and covering said cooling air inlet, said canopy  
4 having at least one inlet and forming a serpentine  
5 pathway between said cooling air inlet and said canopy  
6 inlet to reduce noise emitted from said hollow interior  
7 through said cooling air inlet and said canopy inlet.

1 17. The central vacuum unit according to claim 16,  
2 wherein sound absorbing material is provided along at  
3 least a portion of said serpentine pathway of said  
4 canopy.

1 18. The central vacuum unit according to claim 17,  
2 wherein said sound absorbing material along said  
3 serpentine pathway is an open cell foam.

1 19. The central vacuum unit according to claim 13,

2 wherein canister has an exhaust port and said motor has  
3 an exhaust pipe extending through said exhaust port, and  
4 an exhaust port seal which covers the exhaust port to  
5 reduce noise emitted from the hollow interior through the  
6 exhaust port.

1 20. The central vacuum unit according to claim 19,  
2 wherein said exhaust port seal comprises flexible foam.

CENTRAL VACUUM WITH ACOUSTICAL DAMPINGBACKGROUND OF THE INVENTION

## FIELD OF THE INVENTION

The present invention relates in general to a central vacuum unit and, more particularly, to an acoustical damping system which substantially reduces the level of noise emitted from the central vacuum unit.

## DESCRIPTION OF RELATED ART

Built in vacuum systems typically have a central vacuum unit and a system of vacuum ducts which extend into various rooms of the house. Vacuum inlets are located in walls of selected rooms so that a vacuum hose can be connected to the central vacuum unit. When not in use, the vacuum inlets are covered by plates. To use the central vacuum system, one of the vacuum inlets is opened and the vacuum hose is plugged into the inlet. The central vacuum unit is automatically activated and a suction force draws in dirt and dust through a nozzle attached to the end of the vacuum hose. The central vacuum system provides more cleaning power than conventional portable vacuum cleaners and reduces the necessity of carrying portable vacuum cleaners from room to room. Additionally, the central vacuum system vents exhaust air out of the living area to eliminate the recirculation of unhealthy air.

One major disadvantage of built in vacuum systems known in the prior art, however, is the creation of a substantial amount of noise by the central vacuum unit. In most conventional units known in the prior art, the noise level generated from the central vacuum unit lies in the range of about 75 to about 95 decibels. Even though the central vacuum unit is typically located in a remote area such as the basement or garage of the home, many people use such locations as playrooms, workshops, etc. It is almost impossible to comfortably work in such locations when the central power and suction unit is operating, because the high noise level is sometimes



1 deafening and at best extremely irritating.  
2 U.S. Patent No. 4,938,309, the disclosure of which  
3 is expressly incorporated herein in its entirety by  
4 reference, discloses a built-in vacuum cleaning system  
5 with an acoustic damping design. The motors of the unit  
6 are enclosed within an interior chamber which includes at  
7 its lower end a baffle covered with acoustic foam and is  
8 vented through exhaust ports. Tips of the motor  
9 armatures are separated from the remainder of the  
10 armatures and motor by the baffle. The tips of the  
11 armatures extend into a separate acoustic damping chamber  
12 which is also covered at a lower end with acoustic foam  
13 and includes openings for cooling air. While this  
14 acoustic damping design may reduce the noise level  
15 emitted from the unit while sufficiently cooling the  
16 motor, the noise level remains relatively high.  
17 Accordingly, there is a need in the art for a built-in  
18 vacuum cleaning system with an improved acoustical  
19 damping system to significantly lower the noise level  
20 emitted from the central vacuum unit.

#### 21 SUMMARY OF THE INVENTION

22 The present invention provides a central vacuum unit  
23 with an improved acoustic damping system which overcomes  
24 at least some of the above-noted problems. The central  
25 vacuum unit includes a canister which forms a hollow  
26 interior, a vacuum motor within the canister which emits  
27 noise during operation, at least one opening in the  
28 canister, and an acoustic damping tunnel within the  
29 hollow interior and forming a pathway between the hollow  
30 interior and the opening. The pathway is lined with a  
31 sound absorbing material so that the tunnel reduces noise  
32 emitted from the hollow interior through the opening.

33 According to another aspect of the invention, an  
34 acoustic damping canopy is attached to the outside of the  
35 canister and covers an opening in the canister. The  
36 canopy has at least one inlet and forms a serpentine

1 pathway between the inlet and the opening in the canister  
2 to reduce noise emitted from the hollow interior through  
3 the opening in the canister.

4 According to yet another aspect of the invention the  
5 canister has an exhaust port and the motor has an exhaust  
6 pipe extending through the exhaust port. An exhaust port  
7 seal is provided which completely covers the exhaust port  
8 to reduce noise emitted from the hollow interior through  
9 the exhaust port. The exhaust port seal is preferably  
10 formed from flexible foam.

#### 11 BRIEF DESCRIPTION OF THE DRAWINGS

12 These and further features of the present invention  
13 will be apparent with reference to the following  
14 description and drawings, wherein:

15 FIG. 1 is a front elevational view of a central  
16 vacuum unit according to the invention;

17 FIG. 2. is a fragmented and enlarged view, partially  
18 in cross-section, of a portion of the central vacuum unit  
19 of FIG. 1;

20 FIG. 3 is an exploded view of the central vacuum  
21 unit of FIG. 1;

22 FIG. 4 is a cross-sectional plan view taken along  
23 line 4-4 of FIG. 2;

24 FIG. 5 is a perspective view of a tunnel of the  
25 central vacuum unit of FIG. 1;

26 FIG. 6 is a perspective view of an exhaust port seal  
27 of the central vacuum unit of FIG. 1;

28 FIG. 7 is a cross-sectional plan view taken along  
29 line 7-7 of FIG. 2; and

30 FIG. 8 is a perspective view of an acoustic damping  
31 canopy of the central vacuum unit of FIG. 1..

#### 32 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

33 FIGS. 1-3 illustrate a central vacuum unit 10 with  
34 an acoustical damping system according to the present  
35 invention. The illustrated unit 10 is a model 189

1 manufactured by Beam Industries of Webster City, Iowa.  
2 It is noted, however, that while the model 189 central  
3 vacuum unit is utilized herein to illustrate the present  
4 invention, any conventional central vacuum unit can  
5 include the present invention to reduce the amount of  
6 noise emitted therefrom.

7 The central vacuum unit 10 has a cylindrically-  
8 shaped housing or canister 12 of rolled steel which forms  
9 a hollow interior space. The canister has a side wall  
10 with an air intake port 14 and a vacuum hose port 16  
11 located near the bottom of the canister 12. An on-off  
12 switch 18 is located near the top of the canister 12. A  
13 power cord 20 is provided for connecting the central  
14 vacuum unit 10 to a conventional electrical power source  
15 (not shown). An exhaust port 22 is also located near the  
16 top of the canister 12. Upper and lower mounting  
17 brackets 24, 26 are vertically aligned along a rear face  
18 of the sidewall and provide means for mounting the  
19 canister 12 on a wall. Located in the sidewall near the  
20 top of the canister 12 is a cooling air exhaust or outlet  
21 28 such as the illustrated plurality of slots.

22 A hollow bucket 30 is removably attached to the  
23 bottom of the canister 12 by means such as quick-release  
24 clips 32. Within the canister 12 is a partition wall 34  
25 which is supported by a ledge 36 formed by an inwardly  
26 extending recess 38 formed in the sidewall of the  
27 canister 12. Together the sidewall of the canister 12,  
28 the bucket 30, and the partition wall 34 form a first or  
29 lower interior compartment or chamber 39 within the  
30 hollow interior of the canister 12. A removable dirt and  
31 dust collection bag 40 which is air permeable and is  
32 housed within the lower interior chamber 39. The bag 40  
33 has a flexible rim 42 which rests within an outwardly  
34 extending recess 44 formed in the side wall of the  
35 canister 12.

36 A vacuum motor 46 is housed within a second or upper  
37 interior compartment or chamber 48 which is located above

1 the lower interior chamber 39 and is separated from the  
2 lower interior chamber 39 by the partition wall 34. The  
3 upper interior chamber 48 is formed by the side wall of  
4 the canister 12, the partition wall 34, and a steel lid  
5 50 which closes the upper end of the canister 12. A  
6 vacuum inlet 52 of the vacuum motor 46 is in fluid flow  
7 communication with the lower interior chamber 39 through  
8 an opening 54 in the partition wall 34. A gasket 56 is  
9 provided between the vacuum motor 46 and the partition  
10 wall 34 so that a seal is maintained between the lower  
11 and upper interior chambers 39, 48.

12 A vacuum exhaust pipe 58 of the vacuum motor 46  
13 provides an exit for hot exhaust coming from the vacuum  
14 motor 46 and extends through the exhaust port 22 in the  
15 sidewall of the canister 12. The vacuum exhaust pipe 58  
16 is connected to a muffler 59 which is located outside the  
17 canister 12. The muffler 59 is preferably of the type  
18 disclosed in co-pending application No. 08/546,116, filed  
19 on October 20, 1995, for a "CENTRAL VACUUM CLEANER  
20 MUFFLER", by Steven P. Rittmueller, Douglas E. Johnson,  
21 J. Adin Mann III, and David K. Holger, Docket No. ISURF  
22 #018771 the disclosure of which is expressly incorporated  
23 in its entirety herein by reference.

24 Suction created by the vacuum motor 46 causes a flow  
25 of air into the air intakes 14, 16 of the canister 12,  
26 through the collection bag 40 within lower interior  
27 chamber 39 of the canister 12, and into the vacuum inlet  
28 52 of the vacuum motor 46. The air is exhausted from the  
29 motor 46 through the exhaust pipe 58 and the muffler 59.  
30 Dirt, dust and other debris entrained within the flow of  
31 air is blocked by the collection bag 40 and settles in  
32 the bucket 30. When the bucket 30 is full of dirt, the  
33 snap clips 32 are opened and the bucket 30 is removed so  
34 that the bucket 30 can be emptied.

35 A cooling air inlet 60 of the vacuum motor 46  
36 extends through an opening 62 in the lid 50 so that the  
37 cooling air inlet 60 of the vacuum motor 46 is in fluid

1 flow communication with the exterior of the canister 12.  
2 A gasket 64 is provided between the vacuum motor 46 and  
3 the lid 50 to seal the opening 62 and also thermally  
4 isolate the vacuum motor 46 from the lid 50. Preferably,  
5 the gasket 64 comprises an open cell foam. A cooling air  
6 fan (not shown) of the vacuum motor 46 draws cooling air  
7 through the cooling air inlet 60 of the vacuum motor 46  
8 and over the armatures of the vacuum motor 46. The  
9 cooling air flows over the armatures of the vacuum motor  
10 46, into the upper interior chamber 48, and out the  
11 cooling air outlet 28.

12 The acoustic damping system reduces the amount of  
13 noise emitted from the upper interior chamber 48 through  
14 the cooling air outlet 28, the exhaust port 22, and the  
15 cooling air inlet 60. The acoustic damping system  
16 includes an acoustic damping tunnel 66, an exhaust port  
17 seal 68, and an acoustic damping canopy 70.

18 As best shown in FIGS. 2 and 4, the tunnel 66 is  
19 located within the upper interior chamber 48 for the  
20 purpose of reducing the amount of noise emitted from the  
21 cooling air outlet 28. The tunnel 66 has a first or  
22 inlet end 72 in fluid flow communication with upper  
23 interior chamber 48 and a second or outlet end 74 in  
24 fluid flow communication with the cooling air outlet 28.

25 As shown in FIG. 5, the tunnel 66 of the illustrated  
26 embodiment is generally U-shaped in cross-section having  
27 an inner wall 76, an outer wall 78, and a bottom wall 80  
28 connecting the inner and outer walls 76, 78. The tunnel  
29 66 is preferably molded from a plastic material such as,  
30 for example ABS plastic. The outer wall 78 is arcuate  
31 having a radius slightly less than the sidewall of the  
32 canister 12 and extends for approximately 180 degrees.  
33 The inner wall 76 has an arcuate portion 82 and a  
34 tangential portion 84. The arcuate portion 82 has a  
35 radius slightly greater than the outer surface of the  
36 vacuum motor 46 and extends for approximately 180  
37 degrees. The tangential portion 84 is generally straight

1 and extends from the arcuate portion 82 to the sidewall  
2 of the canister 12. The inner and outer walls 76, 78 are  
3 provided with resilient snap clips 86 which extend  
4 through openings 88 (FIG. 3) in the lid 50 to secure the  
5 tunnel 66 to the lid 50 which both supports the tunnel 66  
6 within the upper interior chamber 48 and closes the open  
7 top 90 of the tunnel 66.

8 The interior pathway formed by the tunnel 66 and the  
9 lid 50 is covered with sound absorbing material such as  
10 an open cell foam. As best shown in FIG. 2, a top foam  
11 element 92, a bottom element 94, and side elements 96, 98  
12 are provided to surround the pathway defined within the  
13 tunnel 66. The foam elements 92, 94, 96, 98 are  
14 preferably at least 1/2 inch thick and preferably  
15 comprise a combustion modified polyether polyurethane  
16 material such as, for example, Char Hyfonic 1 which is  
17 available from Stephenson & Lawyer of Grand Rapids,  
18 Michigan. As best shown in FIG. 4, foam elements 100  
19 surround the outlet end 74 of the tunnel 66 to seal the  
20 outlet end 74 to the sidewall of the canister 12 so that  
21 sound is forced to follow the designed pathway through  
22 the tunnel 66 to exit through the cooling air outlet 28.  
23 As the noise passes through the tunnel 66, the noise is  
24 absorbed by the sound absorbing material.

25 The tunnel 66 is most effective at reducing emitted  
26 noise if the tunnel 66 has the greatest length and width  
27 allowed by the available space within the upper interior  
28 chamber 48 and allowed by heat restrictions. A longer  
29 tunnel 66 forces the noise to travel a longer path past  
30 the sound absorbing material so that more sound can be  
31 absorbed and a wider tunnel 66 allows the use of a  
32 thicker layer of sound absorbing material which yield  
33 more noise reduction. Therefore, various electrical  
34 components 102 within the upper interior chamber 48 are  
35 preferably located near the exhaust port 22 so that the  
36 tunnel 66 can circumferentially extend for substantially  
37 the entire distance around the vacuum motor 46 except for

1 the space occupied by the exhaust pipe 58 and the  
2 electrical components 102 as best shown in FIG. 4. It  
3 can also be seen in FIG. 4 that the width of the tunnel  
4 66 extends substantially from the sidewall of the  
5 canister 12 to the exterior surface of the vacuum motor  
6 46. It is noted that while the pathway formed by the  
7 illustrated tunnel 66 is generally arcuate or curved,  
8 other tunnels can form effective sound absorbing pathways  
9 of other shapes. The pathways should, however, include  
10 curves or turns so that the pathways not entirely  
11 straight or linear. The pathway of the illustrated  
12 tunnel 66 includes a curve which extends for  
13 approximately 180 degrees.

14 The exhaust port seal 68 reduces the amount of noise  
15 emitted from the exhaust port 22. As shown in FIG. 6,  
16 the exhaust port seal 68 is formed from a rectangular  
17 sheet of material which is generally arcuate to conform  
18 with the sidewall of the canister 12. The exhaust port  
19 seal 68 is preferably formed of a material with either a  
20 high transmission loss or a high absorption rate to  
21 either block or absorb sound that would otherwise be  
22 emitted from the upper interior chamber 48 through the  
23 exhaust port 22. The exhaust port seal preferably  
24 comprises a flexible foam such as, for example, 8443  
25 Neoprene blend which is available from Lundell  
26 Manufacturing of Minneapolis, Minnesota. The exhaust  
27 port seal 68 forms a circular opening 104 for the exhaust  
28 pipe 46. The opening 104 is sized for an interference  
29 fit with the exhaust pipe 58 to provide a seal between  
30 the exhaust pipe 58 and the exhaust port seal 68. As  
31 best shown in FIG. 6, the exhaust port seal 68 is  
32 attached to the sidewall of the canister 12 with an  
33 adhesive to completely close the exhaust port 22.

34 As best shown in FIGS. 2 and 7, the canopy 70 is  
35 attached to the top of the central vacuum unit 10 and  
36 encloses the cooling air inlet 60 of the vacuum motor 46  
37 to reduce the noise emitted from the cooling air inlet

1 60. The canopy 70 is preferably molded of a plastic  
2 material such as, for example, an ABS plastic. As best  
3 shown in FIG. 8, the canopy 70 has a dome portion 106 and  
4 a cylindrically-shaped side portion 108. A plurality of  
5 ribs 110 extend inwardly from the side portion 108 and  
6 provide a plurality of abutments 112 for engaging the lid  
7 50 to support the canopy 70 on the lid 50. Additionally,  
8 a plurality of fastener openings 114 are provided in the  
9 side portion for accepting fasteners which attach the  
10 canopy 70 to the canister 12.

11 Parallel and spaced-apart dividing walls 116, 118,  
12 120, 122 extend from the dome portion 106 and the side  
13 portion 108 within the canopy 70. When the canopy 70 is  
14 attached to the canister 12, the lid and canopy 12 forms  
15 a pair of outer chambers or sections 124, 126, a pair of  
16 intermediate chambers or sections or 128, 130, and a  
17 central chamber or section 132, as best shown in FIG. 7.  
18 Openings or slots 134 are provided in the dome portion  
19 106 at each of the outer sections 124, 126 so that the  
20 outer sections 124, 126 are in fluid communication with  
21 the exterior of the canopy 70 when the canopy 70 is  
22 attached to the canister 12. The outer walls 116, 118  
23 each form a passage 136, 138 at a first end so that the  
24 outer sections 124, 126 are in fluid communication with  
25 the intermediate chambers 128, 130 at the first end. The  
26 inner walls 120, 122 each form a passage 140, 142 at a  
27 second end, opposite the passages 136, 138 of the outer  
28 walls 116, 118, so that the intermediate sections 128,  
29 130 are in fluid communication with the central chamber  
30 132. The central chamber 132 is in fluid communication  
31 with the cooling air inlet 60 of the vacuum motor 46 as  
32 best shown in FIG. 7.

33 As best shown in FIG. 2, a layer of sound absorbing  
34 foam 144 is located between the canopy 70 and the lid 50.  
35 The layer of foam 144 includes a central opening 146  
36 (FIG. 3) for the cooling air inlet 60 of the vacuum motor  
37 46. The foam layer 144 is preferably at least 1/2 inch



1 thick and preferably comprises a combustion modified  
2 polyether polyurethane material such as, for example,  
3 Char Hyfonic 1 which is available from Stephenson &  
4 Lawyer of Grand Rapids, Michigan. The layer of sound  
5 absorbing foam 144 both absorbs sound and seals the  
6 pathway between the sections 124, 126, 128, 130 of the  
7 canopy 70 so that sound is forced to follow the designed  
8 serpentine-shaped pathway of the canopy 70. Each of the  
9 serpentine pathways of the illustrated canopy 70 includes  
10 two 180 degree turns. The canopy 70 is designed so that  
11 noise from the motor cooling fan must travel through the  
12 serpentine-shape pathway of the canopy 70 past the layer  
13 of foam 144 before exiting through the slots 134. It is  
14 noted that additional sound absorbing foam can be added  
15 to the top and/or sides of the serpentine passageway.  
16 However, the additional foam only increases the noise  
17 reduction of the canopy 70 by about 1 db. It is noted  
18 that the serpentine pathway formed by the canopy 70 can  
19 form effective sound absorbing pathways of other shapes.  
20 A serpentine pathway is defined herein as a pathway  
21 including at least one curve or at least one turn so that  
22 the pathway not entirely straight or linear.

23 The acoustic damping system described hereabove is  
24 effective to substantially reduce the noise level of the  
25 central vacuum unit 10. For example, in the embodiment  
26 described hereabove, the overall noise level of the  
27 central vacuum unit 10 was reduced about 10 db with the  
28 most significant reductions of about 13 db, about 12 db,  
29 and about 12 db occurring in the 1,000 Hz, 2,000 Hz, and  
30 the 4,000 Hz octave bands respectively.

31 Although particular embodiments of the invention  
32 have been described in detail, it will be understood that  
33 the invention is not limited correspondingly in scope,  
34 but includes all changes and modifications coming within  
35 the spirit and terms of the claims appended hereto.

Fig. 1

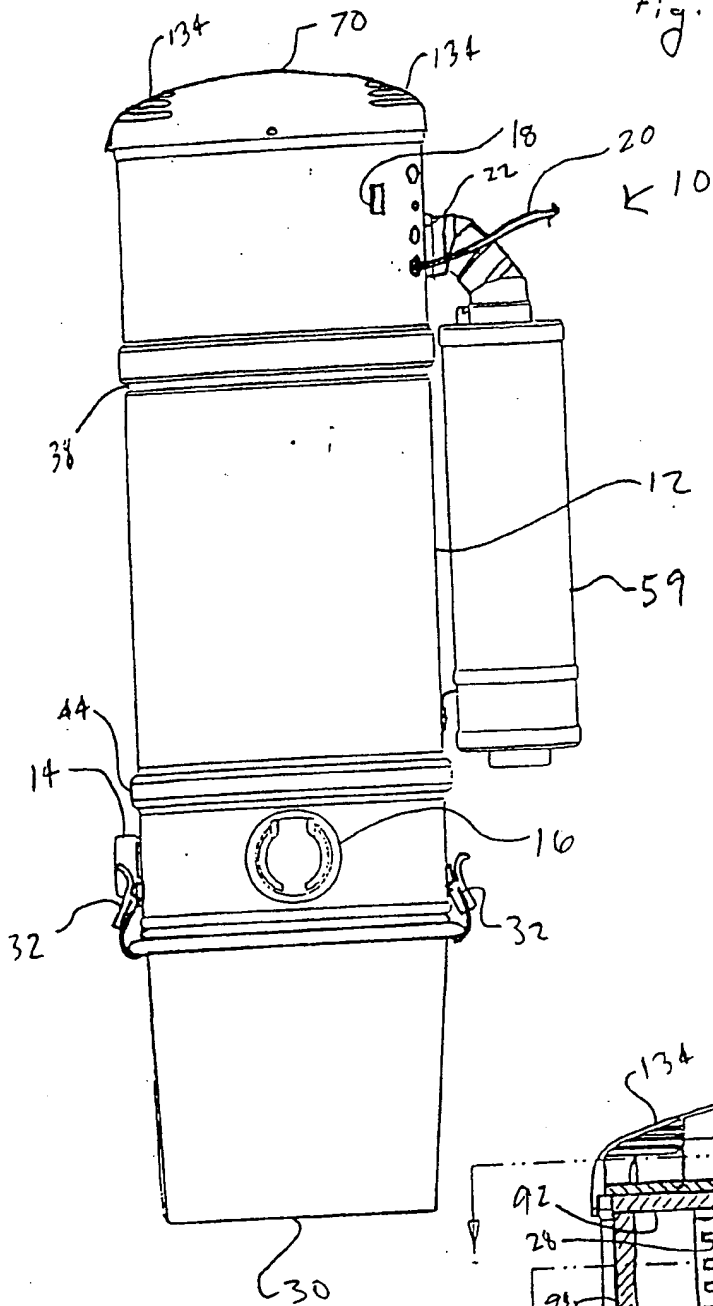
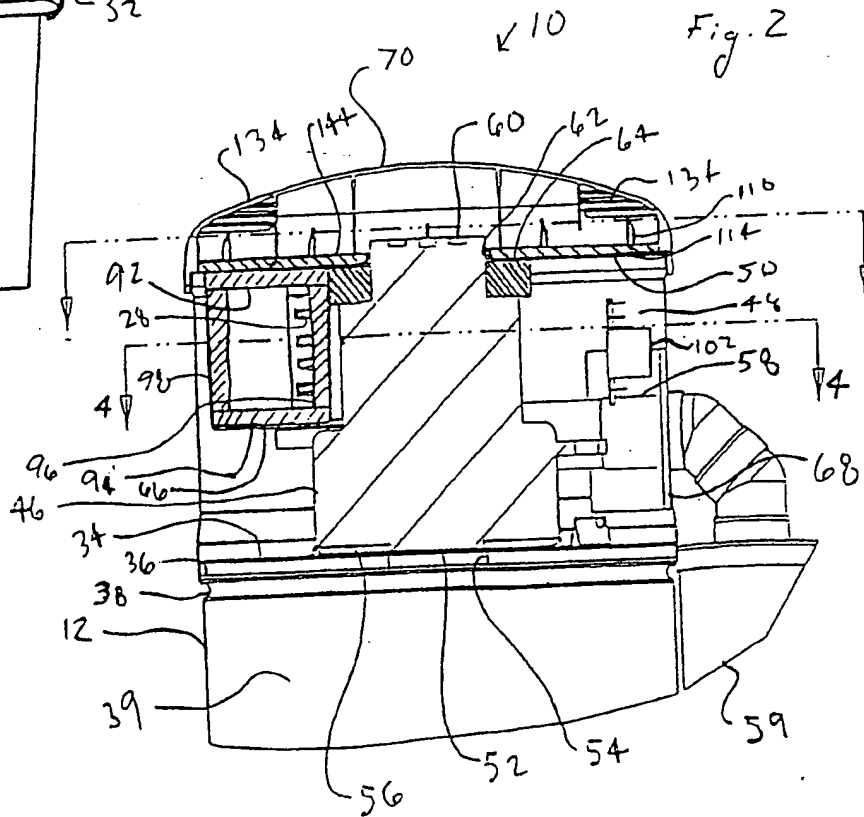


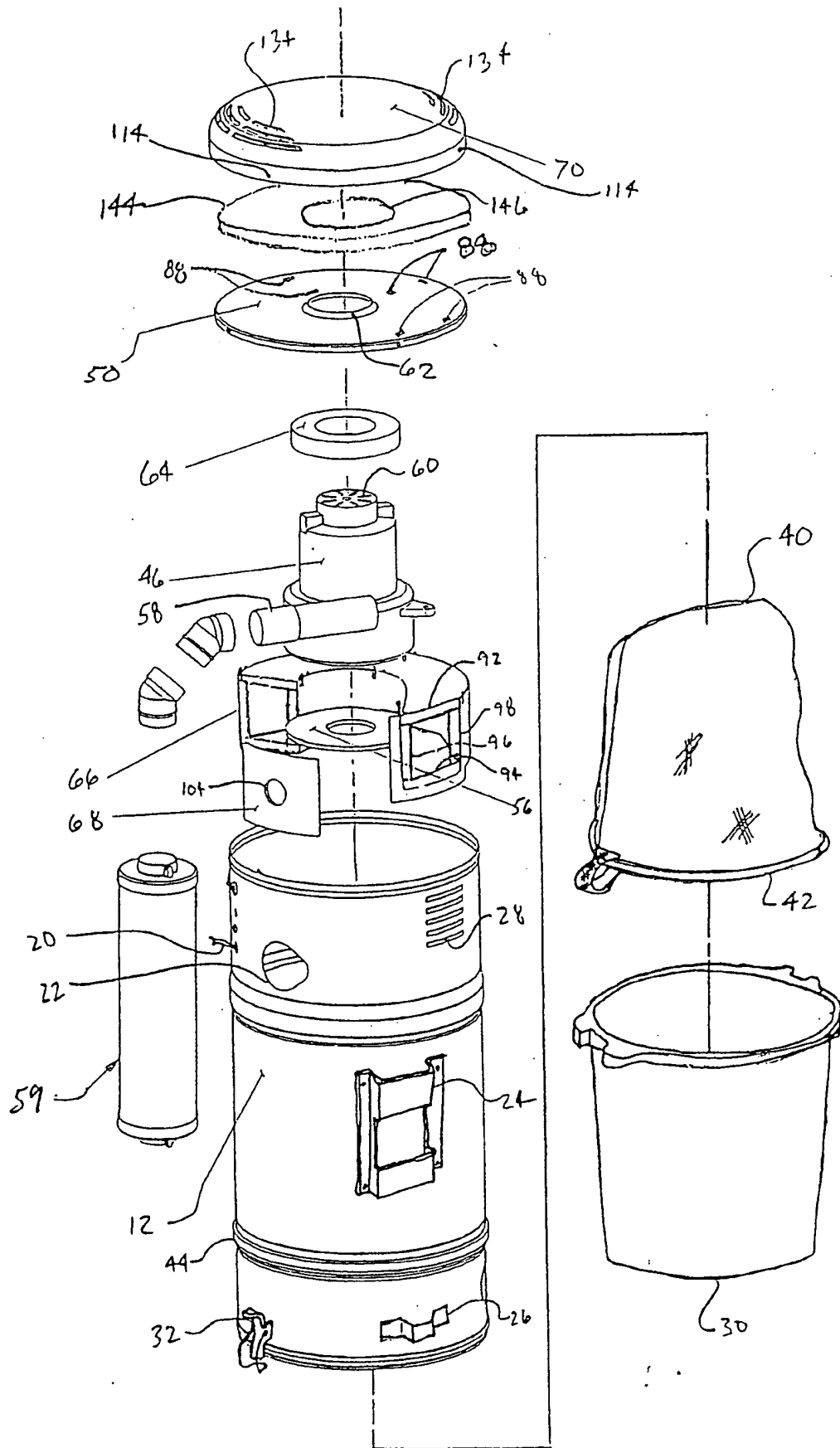
Fig. 2



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Fig. 3

10 →



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Fig. 4

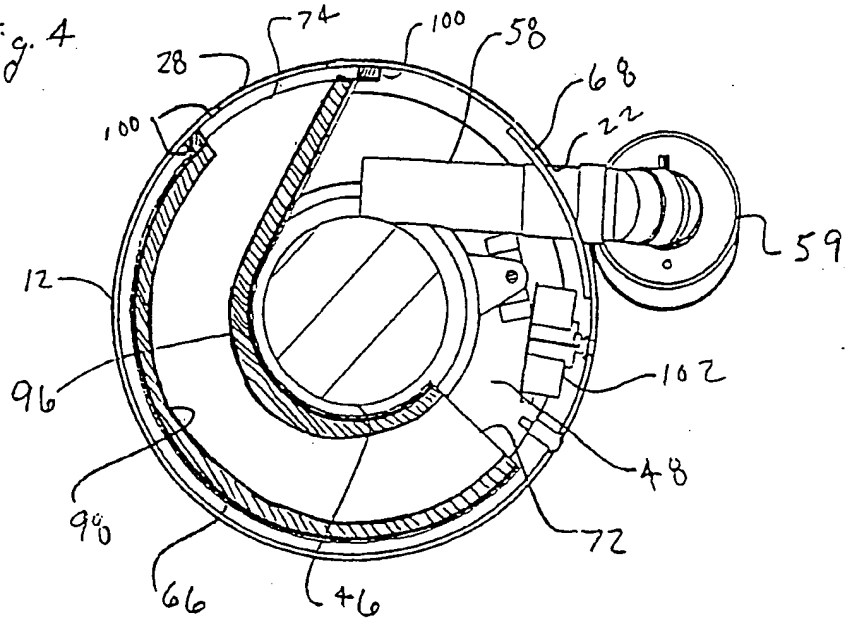


Fig. 5

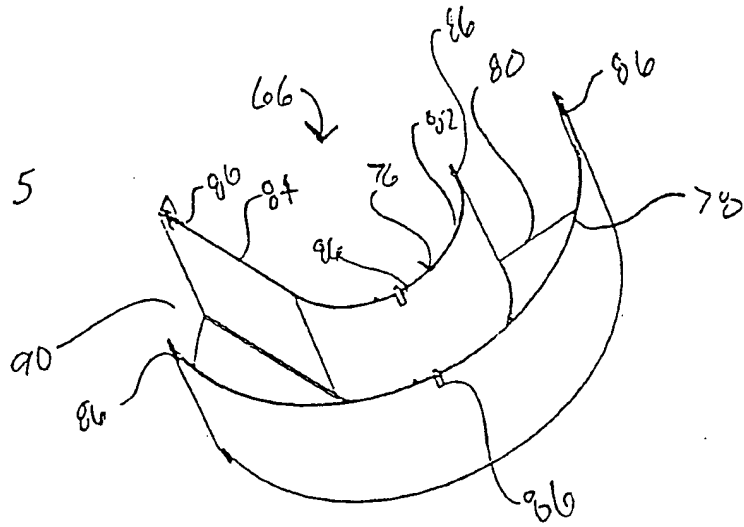
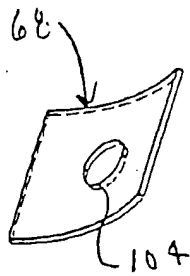


Fig. 6



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Fig. 7

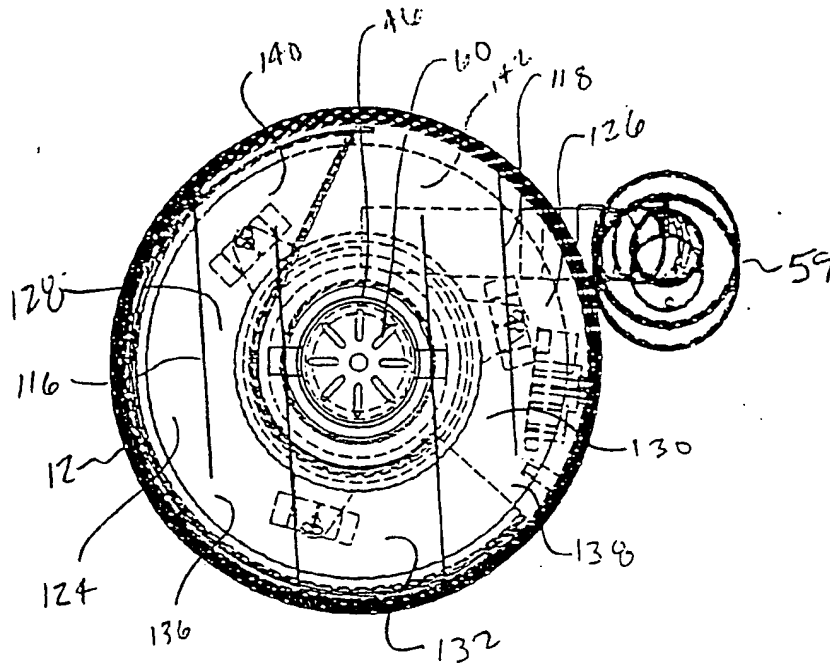


Fig. 8

